



A case study of point precision based on RTK service

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Outline

- RTK services in east TX
- Case study
 - Data collection
 - Data analysis
- Conclusion

RTKnet.com



Trimble® Pivot Web

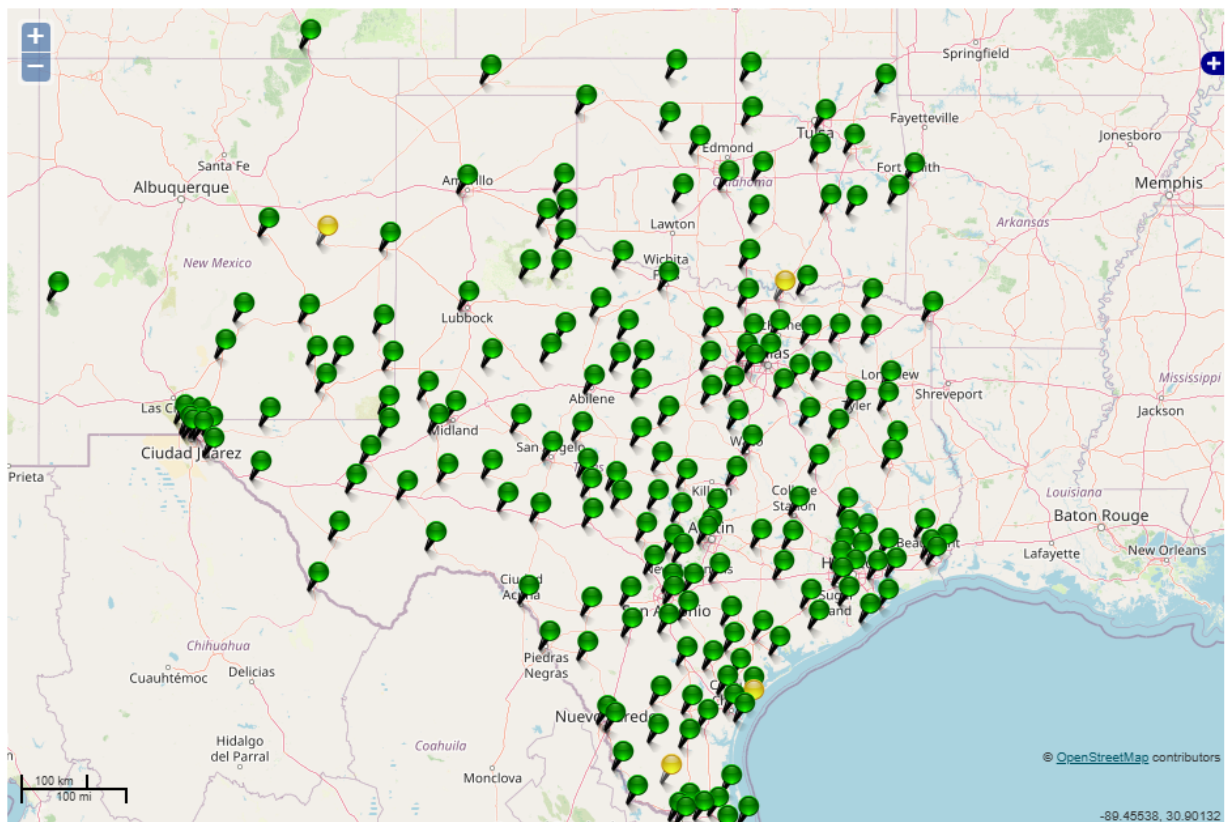
Home > Sensor Map

- Home
 - Sensor Map
 - Position Scatter Plot
 - Status Messages
- Network Information
 - I95 Ionosphere
 - IRIM/GRIM
- Reference Data Shop
- My Account
 - Personal Data
 - Change Password
 - Logins
 - Sessions
- Active Subscriptions
- Organization Details
 - Active Subscriptions
 - Expiring Subscriptions
- Logout
- External Links
 - Trimble

Logged in as Stephen F Austin State University/zhangy2@sfasu.edu

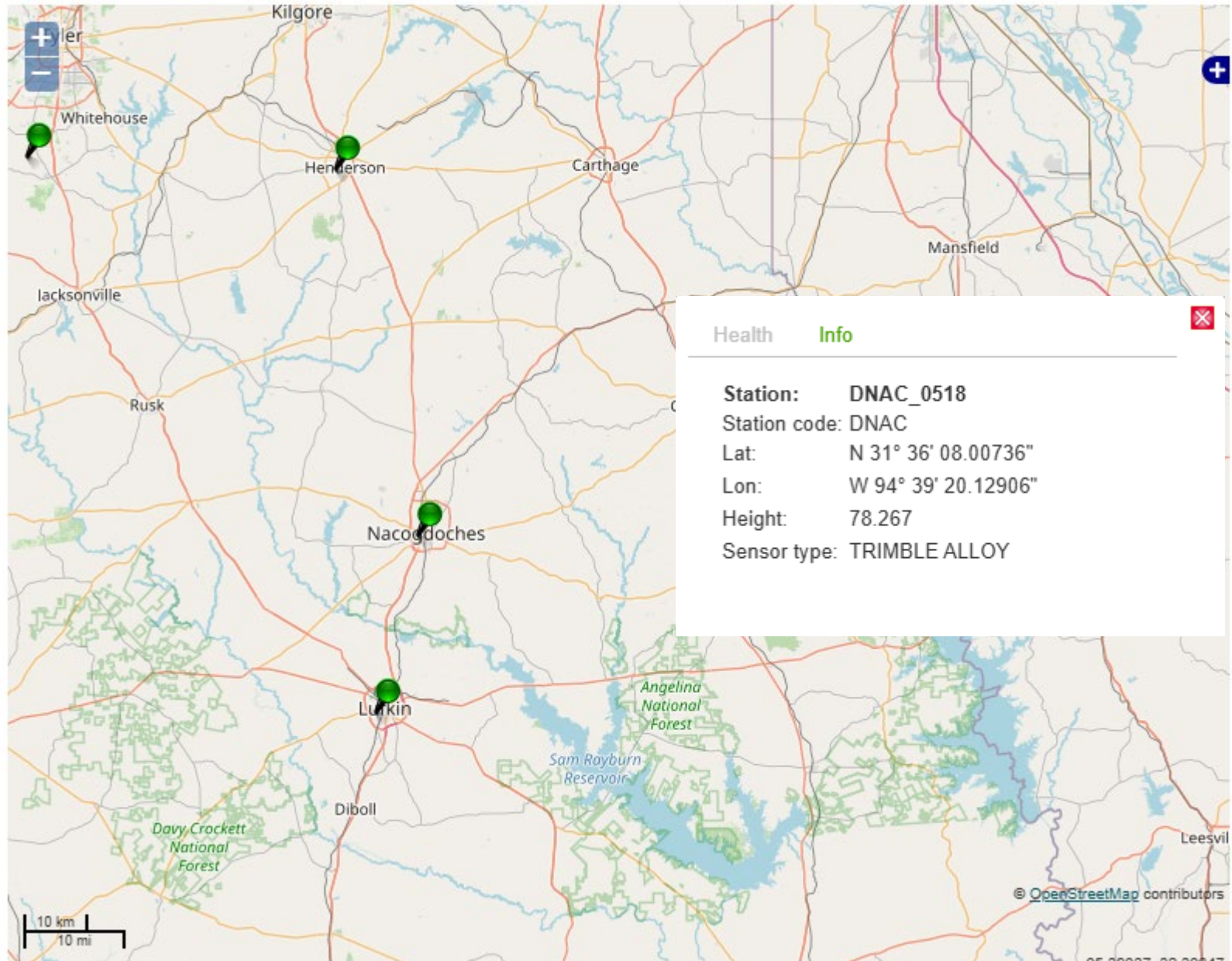


Sensor Map



- 212 sensors:
- CAPA_0219
 - CAPB_0519
 - CAPG_1022
 - CGFB_1012
 - CKPT_1012
 - CNCO_0324
 - CUPA_0318
 - CURB_1012
 - CXTD_1022
 - DAAS_0115
 - DABS_1119
 - DAPA_0522
 - DAPB_0522
 - DAPD_0124
 - DAPR_0522
 - DAPT_0522
 - DARC_1018
 - DBIS_0122
 - DCLB_0714
 - DCOE_0114
 - DDDM_0519
 - DINC_1218
 - DKNG_0715
 - DKTO_1012
 - DLDH_1018
 - DLIS_1012
 - DLMP_0623
 - DLUF_1221
 - DMCL_1014
 - DMLJ_1012
 - DMNT_0715
 - DNAC_0518
 - DOWT_0724
 - DPKC_1012
 - DPKW_0122

Sensor Map





LSU CENTER FOR GEOINFORMATICS

"Positioning Louisiana for the future"



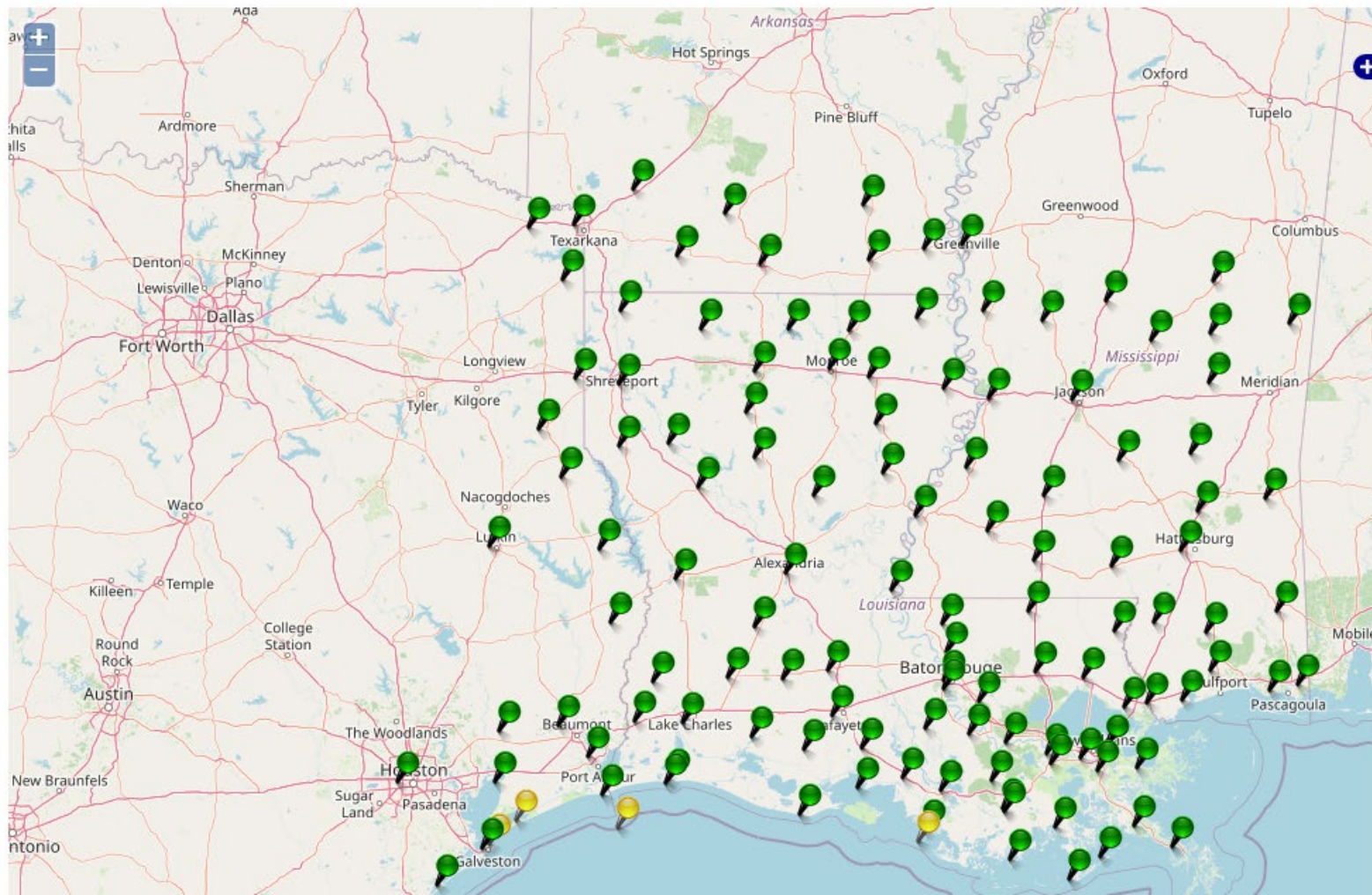
C4Gnet.XYZ Real Time Network

> Home > Sensor Map

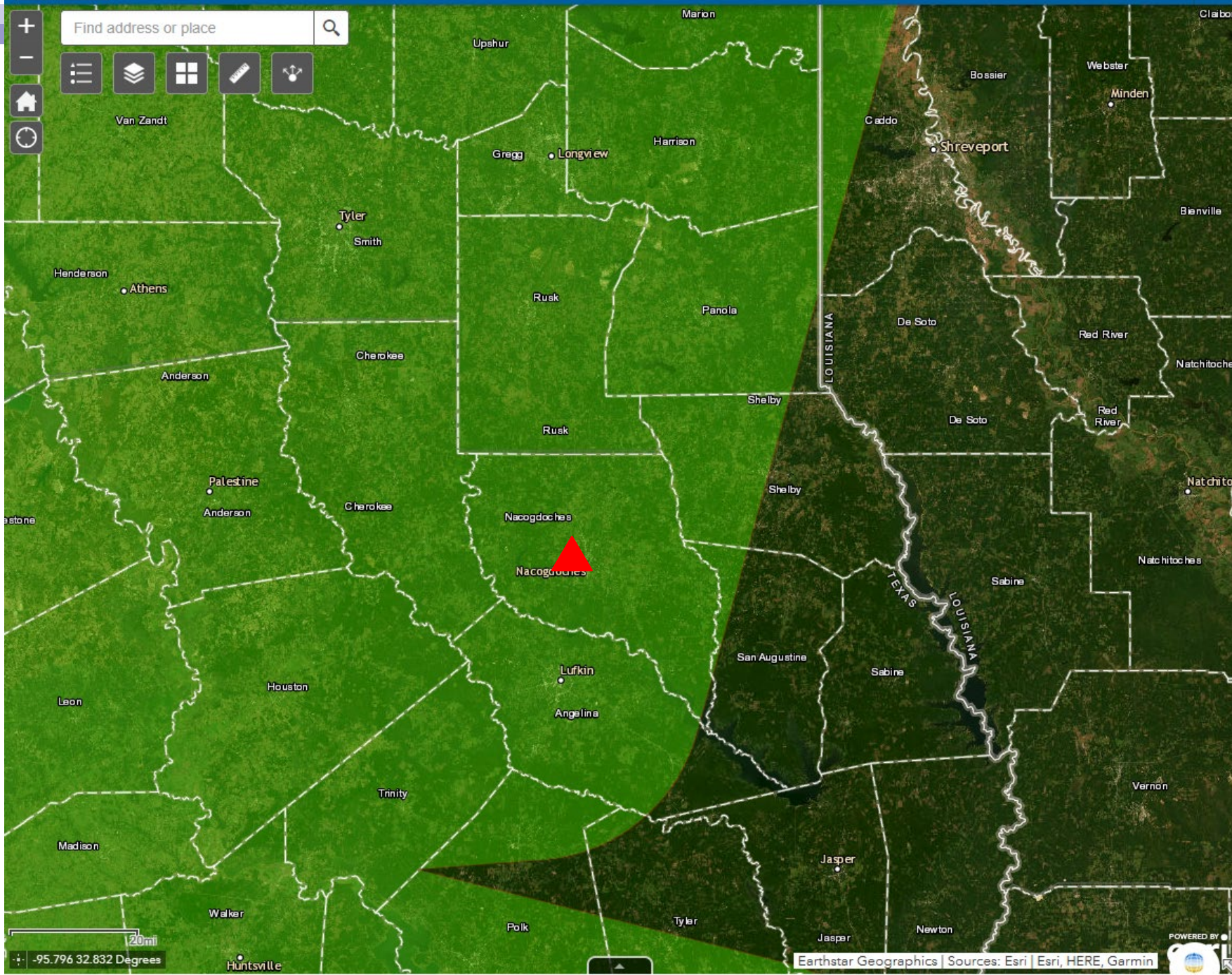
- ▼ Home
 - ▶ Sensor Map
 - ▶ Login
 - ▶ Register
- ▼ External Links
 - ▶ Status Messages
 - ▶ Subscribe
 - ▶ NTRIP and Mountpoints
 - ▶ Best Practices
 - ▶ User Guide
 - ▶ New Visitor Information
 - ▶ C4G
 - ▶ Trimble



Sensor Map

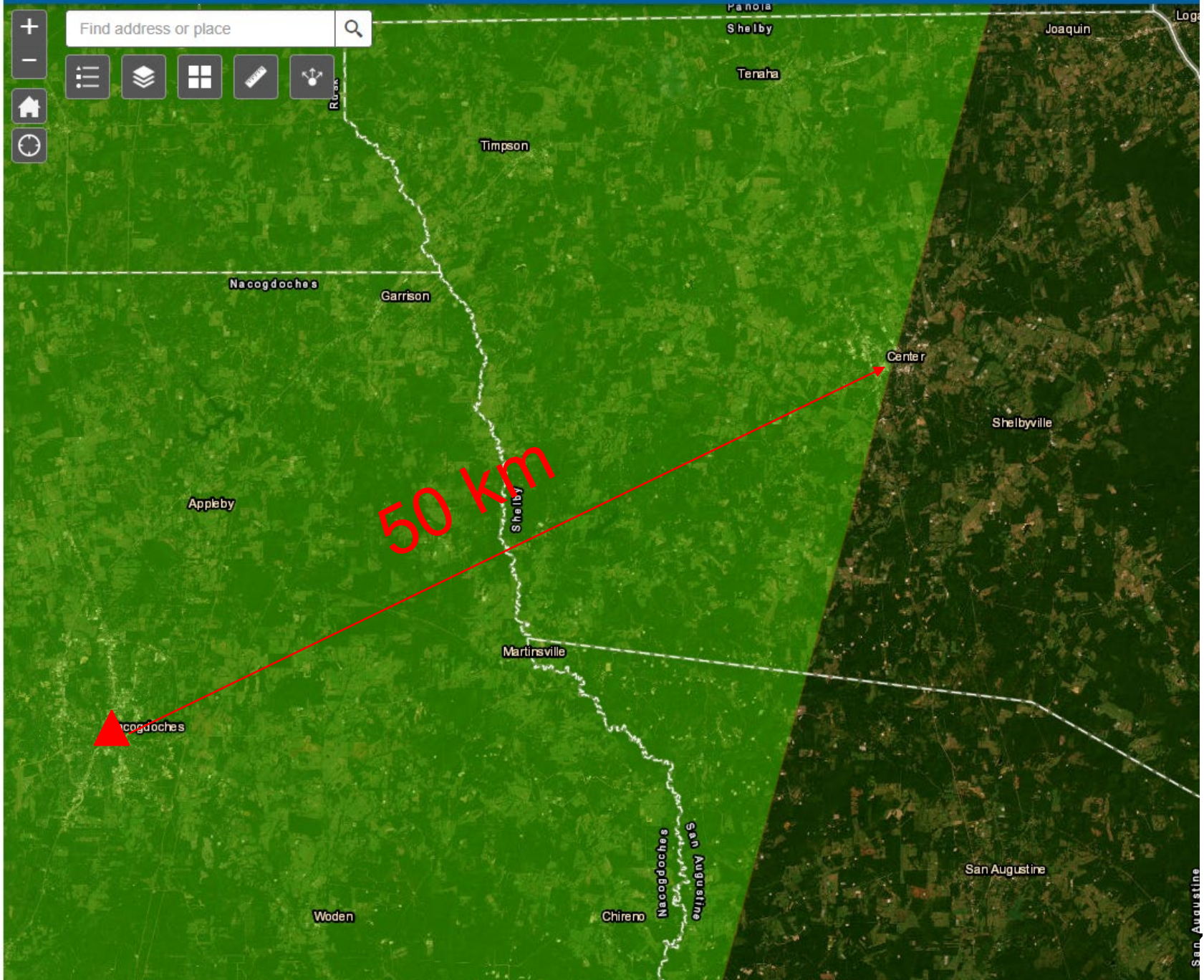
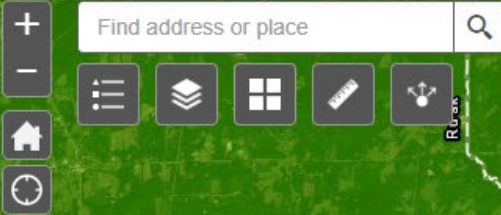


Find address or place



20mi
-95.796 32.832 Degrees

Find address or place



How many miles?

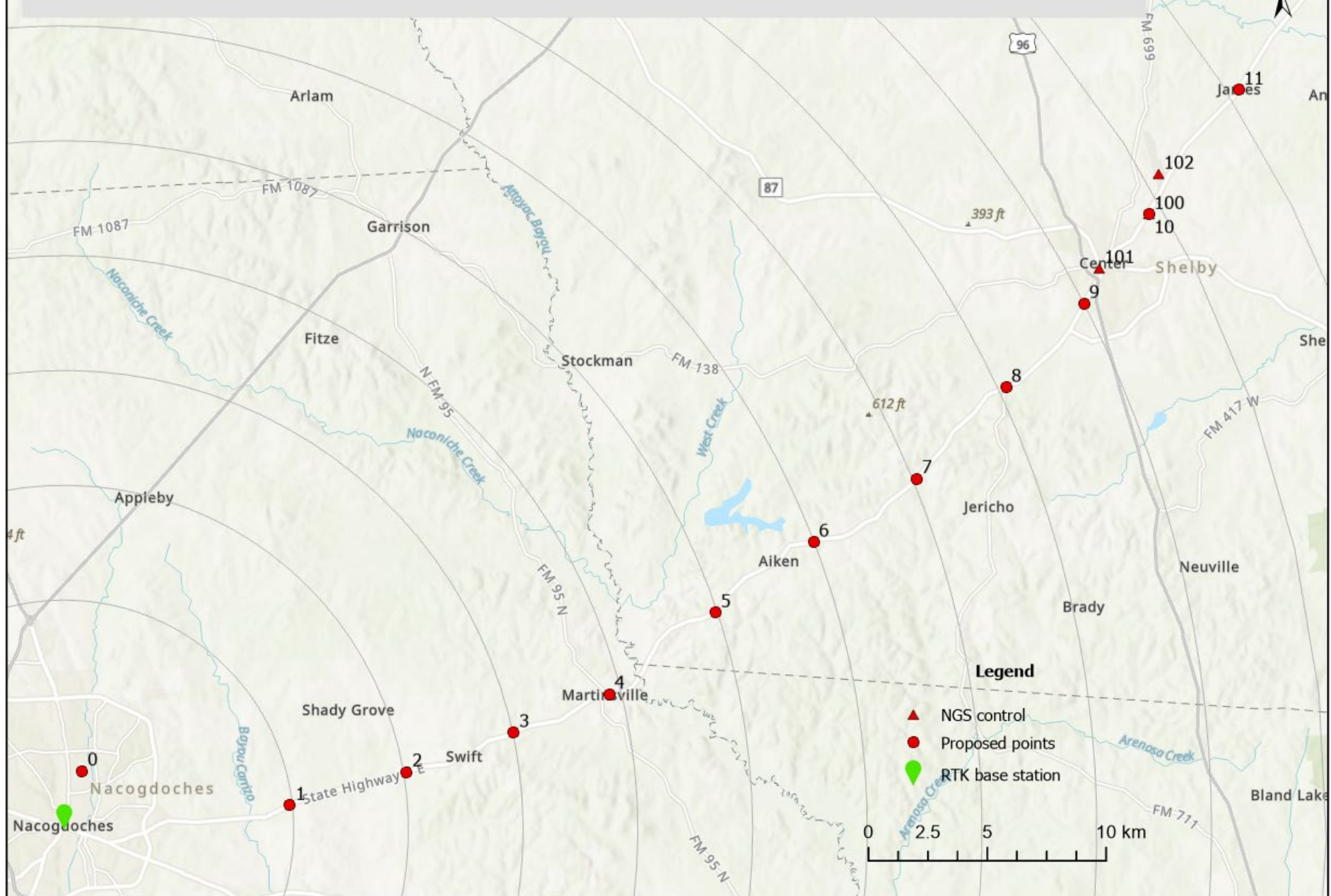
- Can we completely rely on this service?
- How reliable is the RTK service if the surveyor is _____ km away from the base station?

Units

- Trimble R12i
- Android phone with ESRI Field Maps
 - Automatically upload data to GIS environment
 - Very limited setting when comparing with Trimble Access on Data Collector



NGS control points and proposed RTK test points





Site verification

- Internet connection

- No mobile company covers the entire region

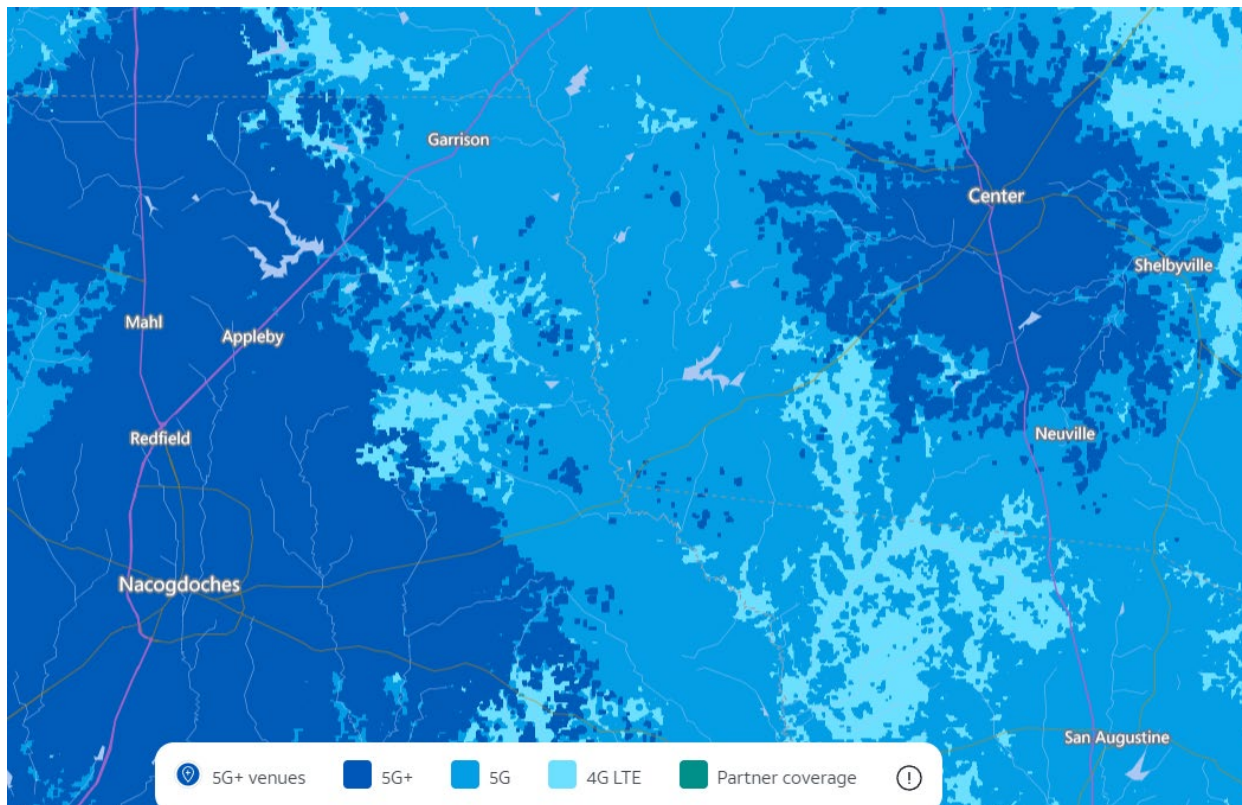
- Safety

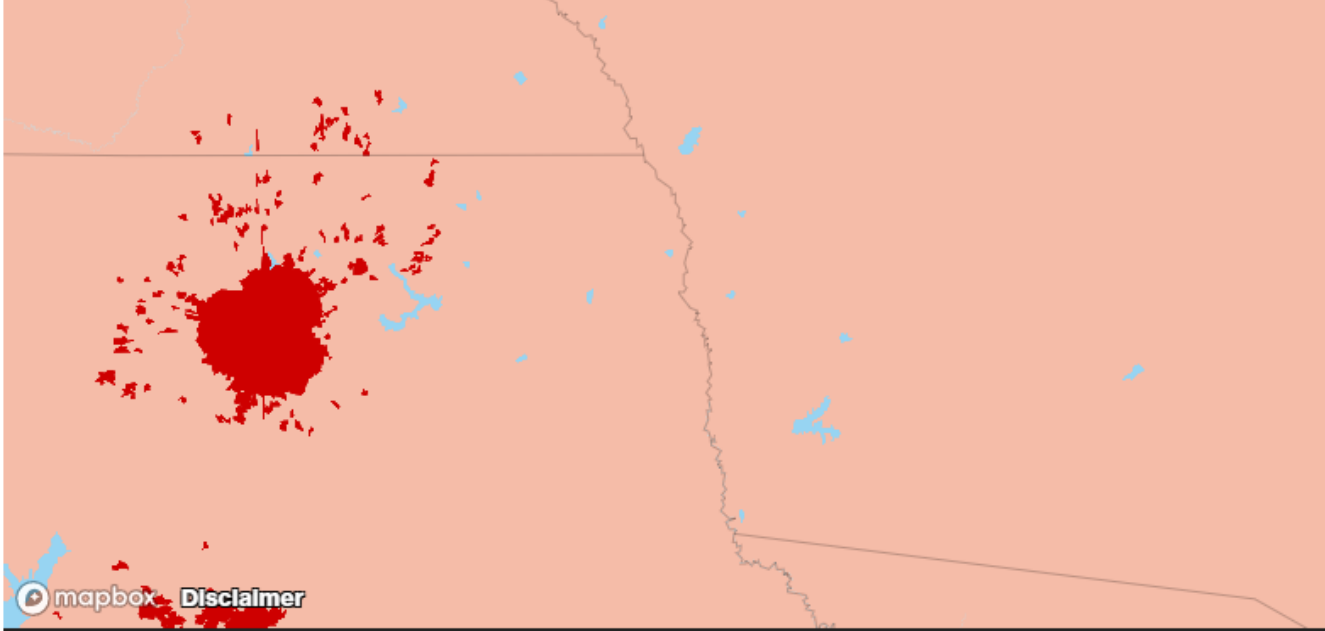
- Speed limit 75 miles/hour (120 km/hour)

Internet coverage

- No system covers the area 100%

ATT



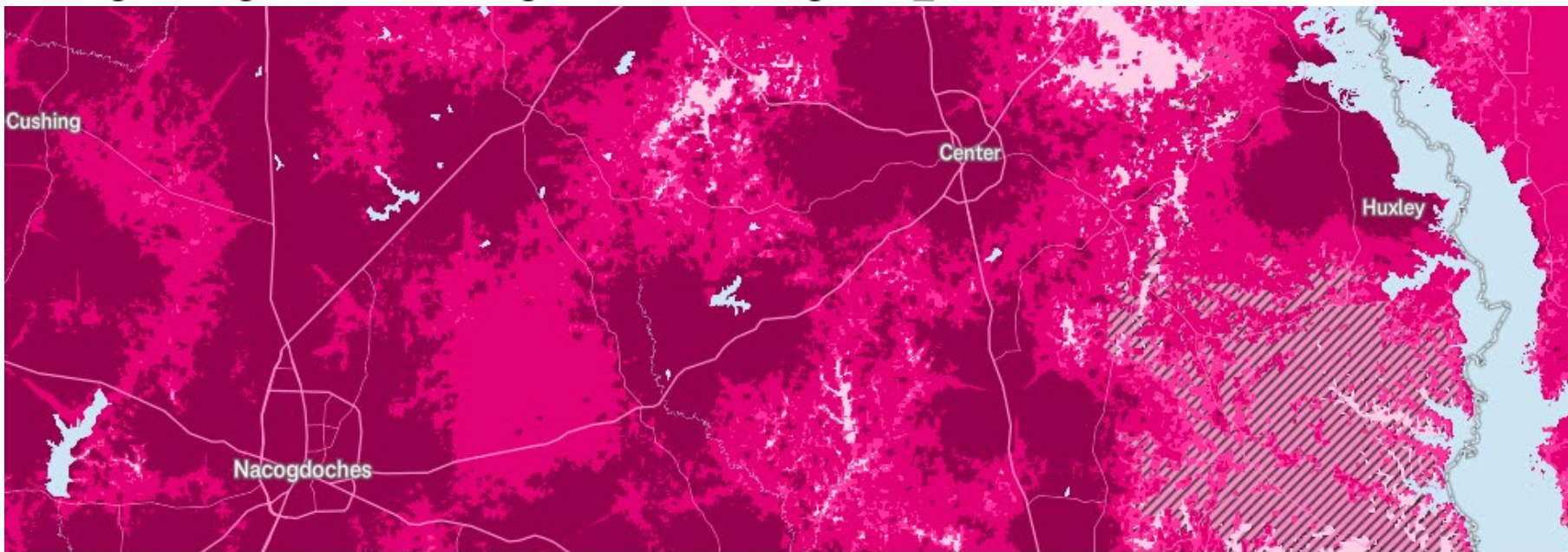


Verizon

Enter your address in the search bar to find your mobile coverage and how

- 5G Ultra Wideband ⓘ
- 5G ⓘ
- 4GLTE ⓘ
- International ⓘ
- No Coverage

Tmobile



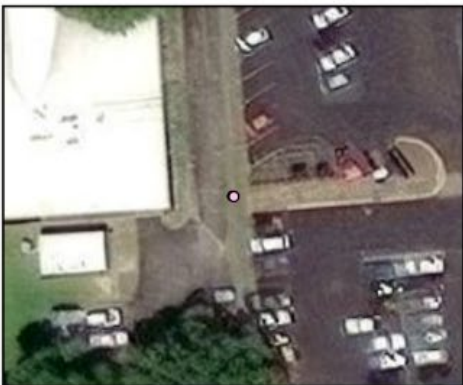
- 5G Ultra Capacity
- 5G Extended Range
- 4G LTE
- 3G/2G
- Satellite
- Partner
- Partner: Canada and Mexico
- No coverage ⓘ

Hotspot

- “Connects to Multiple Carriers: Mobile hotspot provides up to 24 hours of reliable and safe WiFi coverage worldwide via a virtual multi-carrier network for your worldly adventures or business trips.”
- Seems ok







Point 0



Point 1



Point 2



Point 3



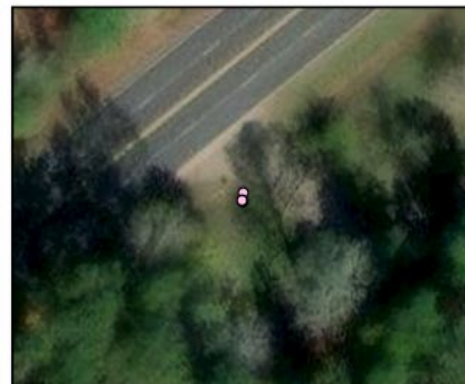
Point 4



Point 5



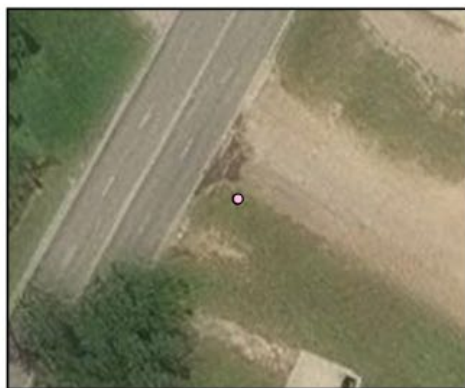
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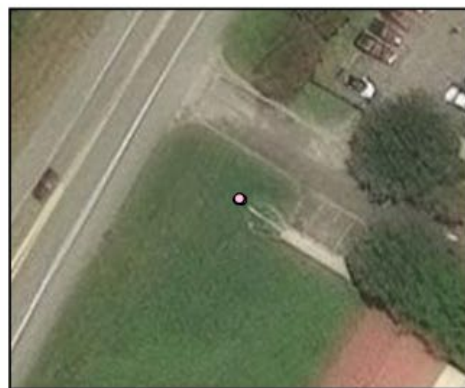
Point 7



Point 8



Point 9

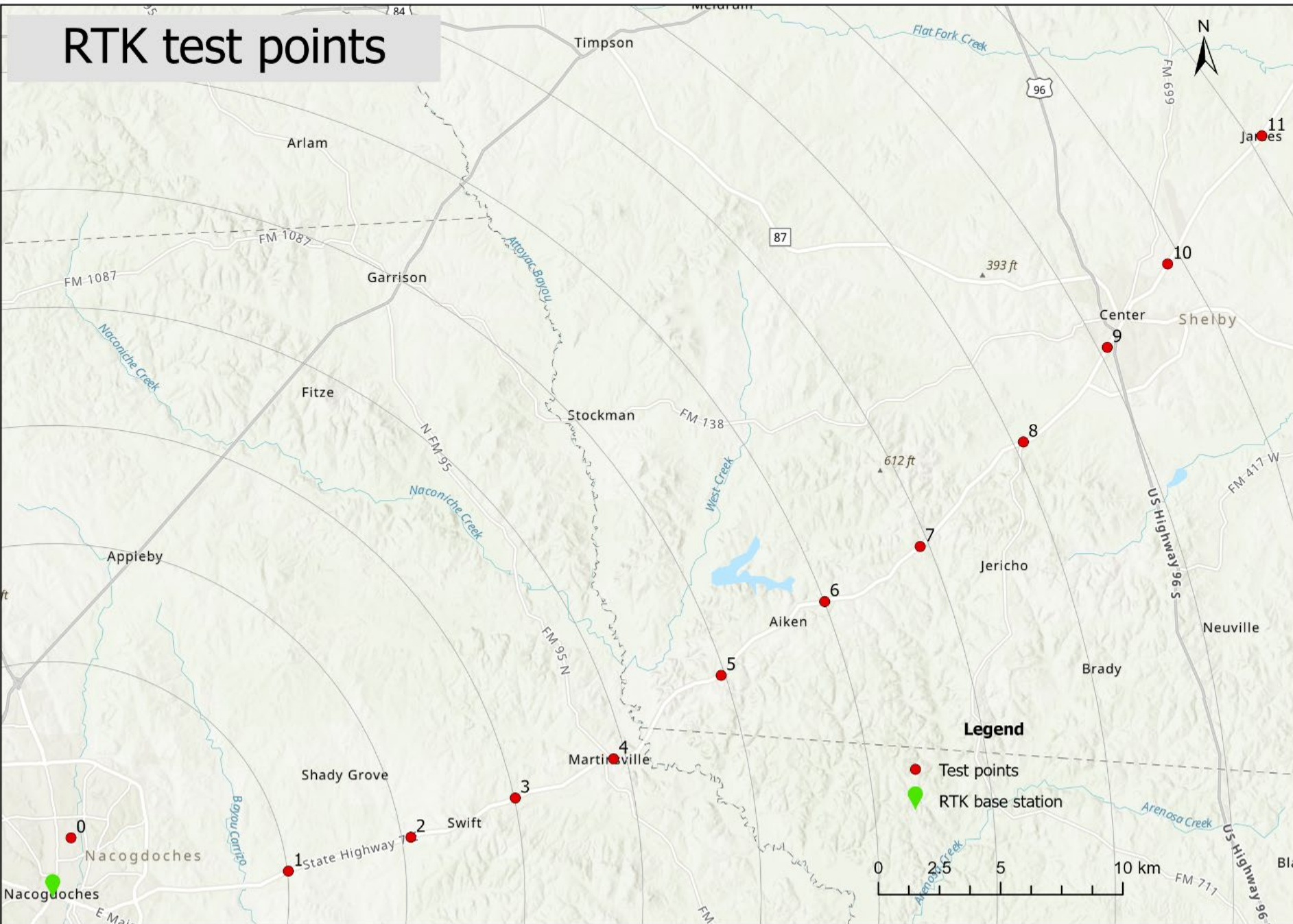


Point 10



Point 11

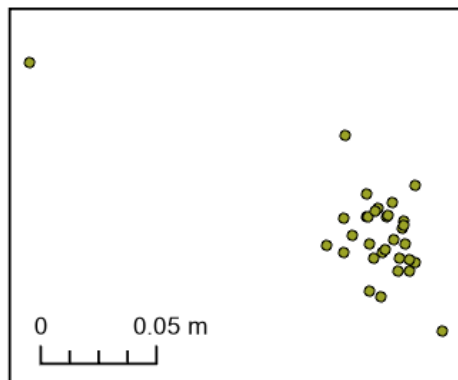
RTK test points



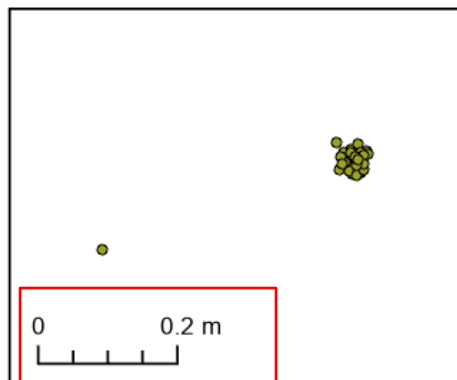


Data collection

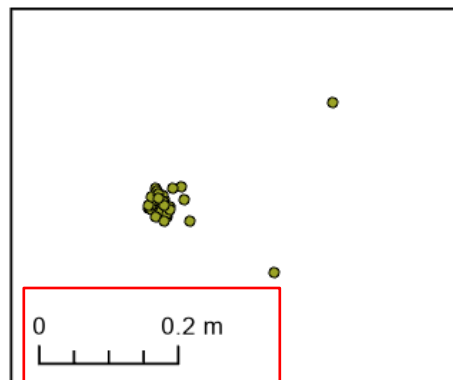
- At least 30 times for every point
- At least 4 hours gap between each data collection



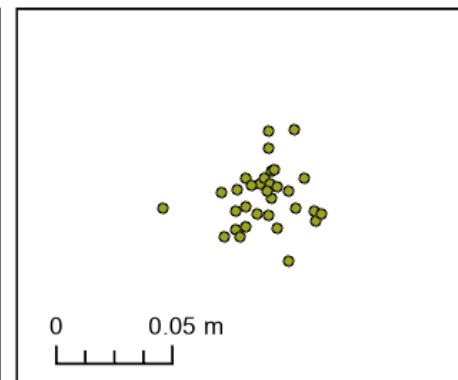
Point 0



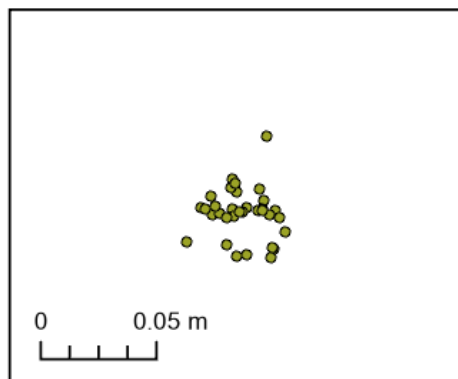
Point 1



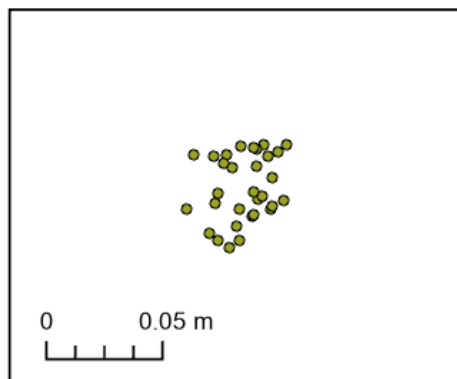
Point 2



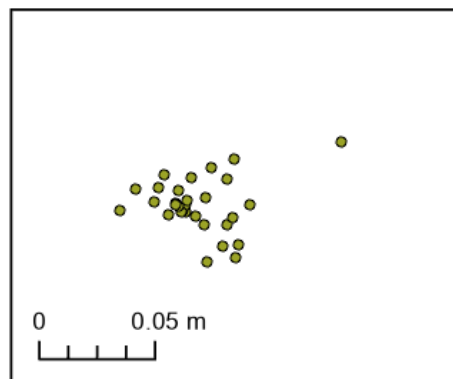
Point 3



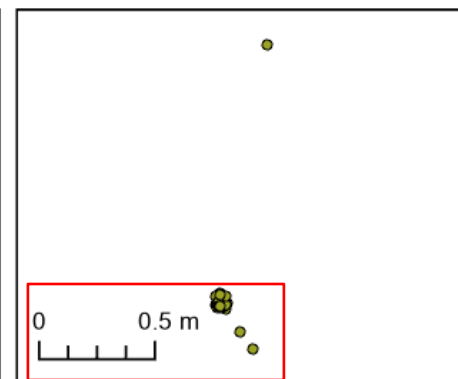
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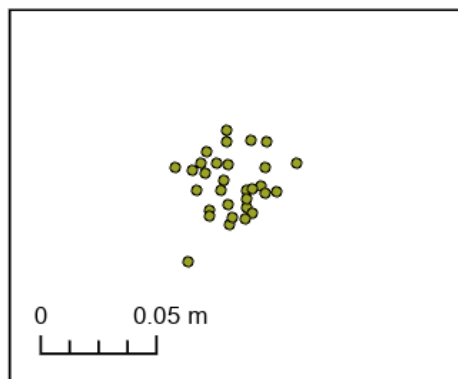
Point 5



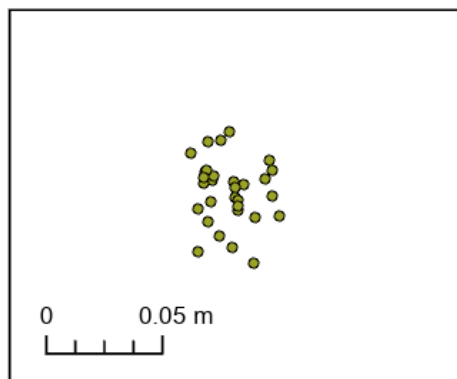
Point 6



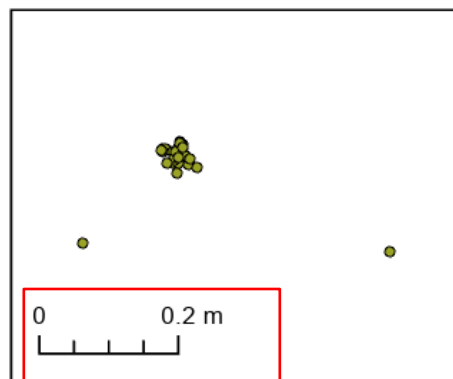
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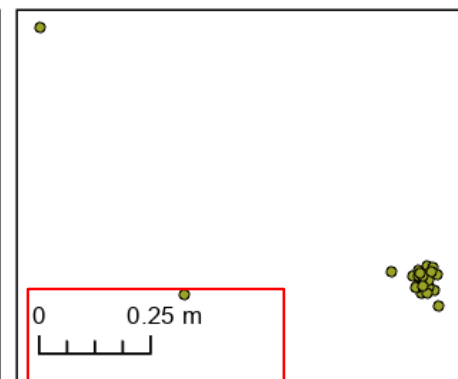
Point 8



Point 9



Point 10



Point 11

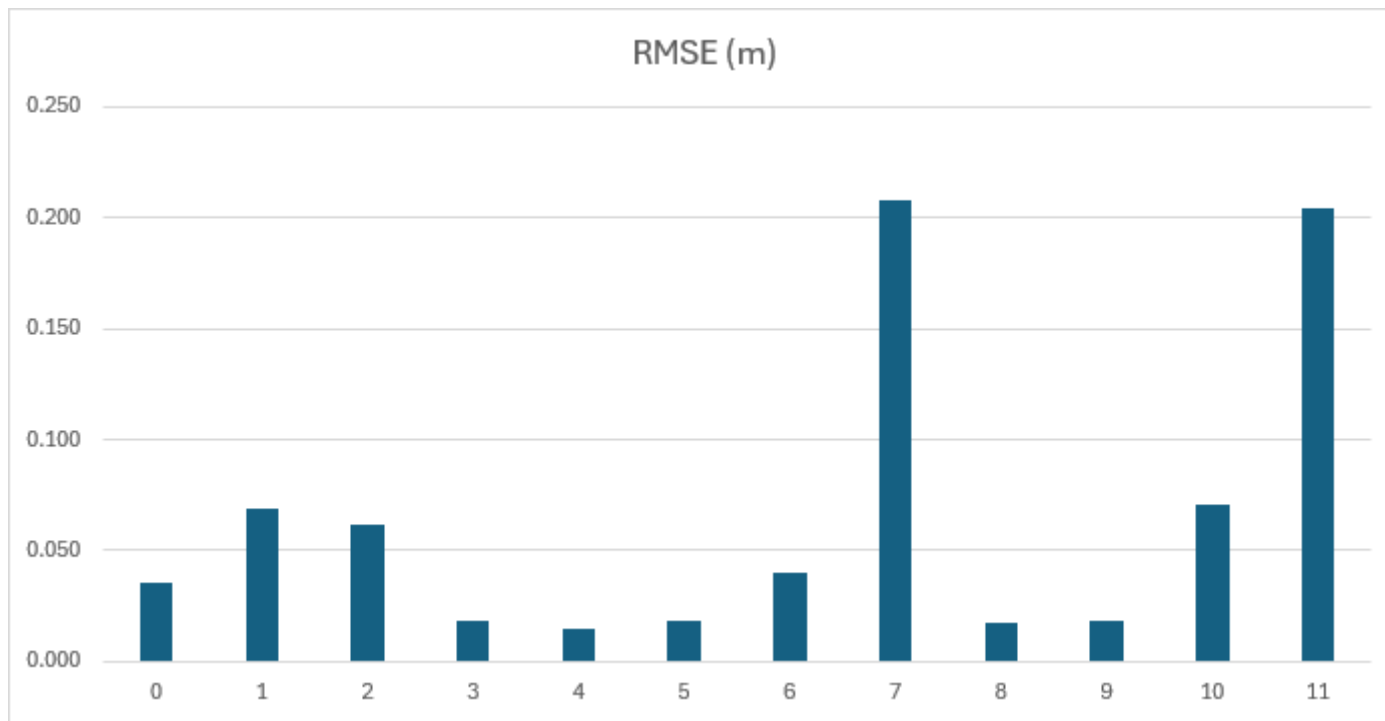
RMSE

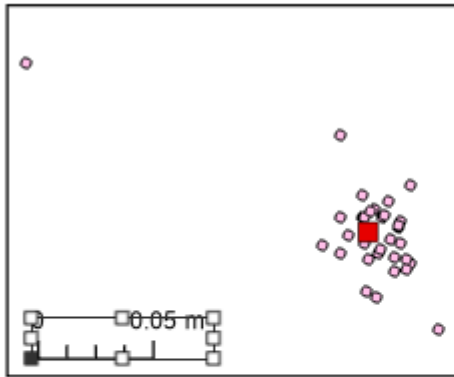
- Formula

$$RMSE = \sqrt{\frac{1}{n+1} \sum_{i=0}^n ((x_i - \bar{x})^2 + (y_i - \bar{y})^2)}$$

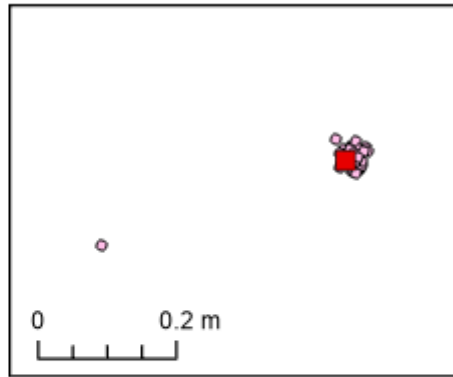
RMSE

■ Plot

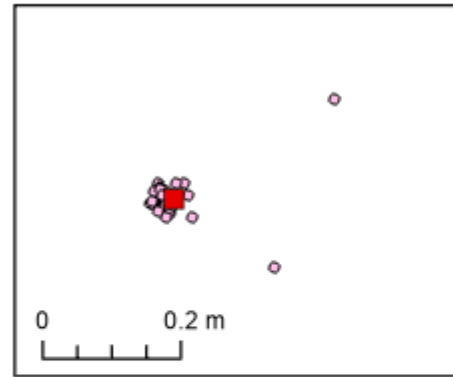




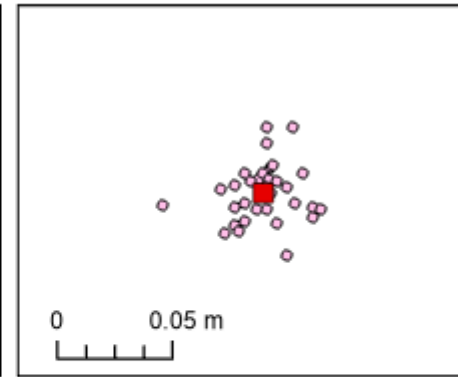
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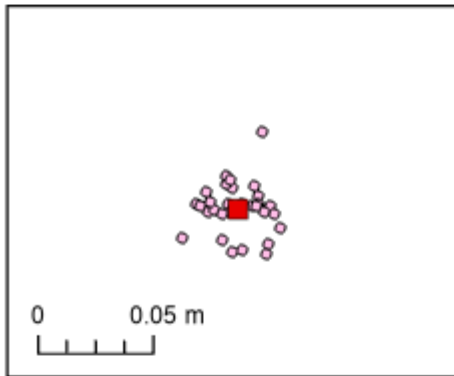
Point 1



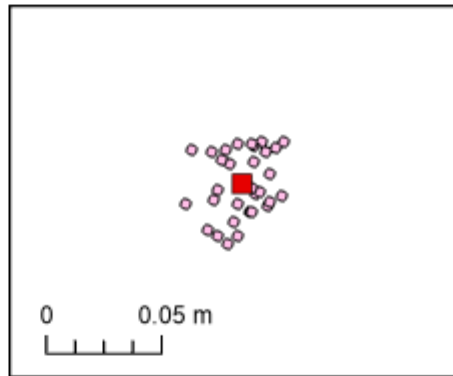
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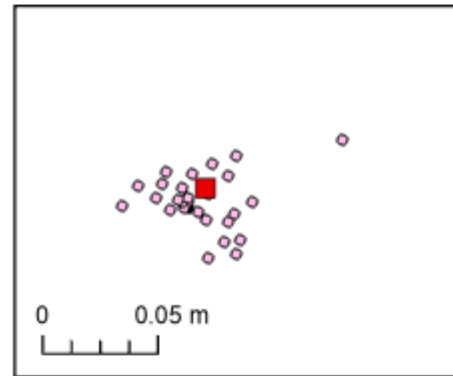
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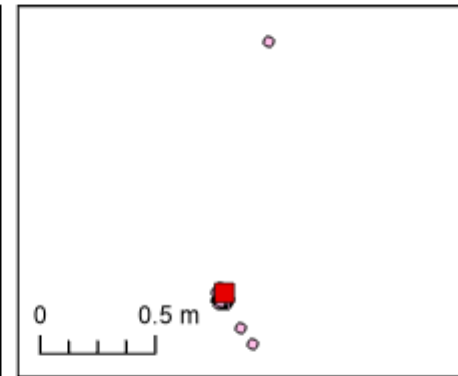
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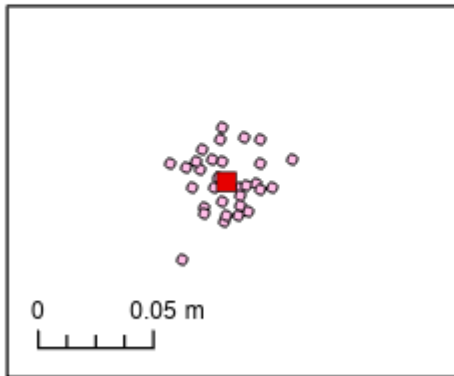
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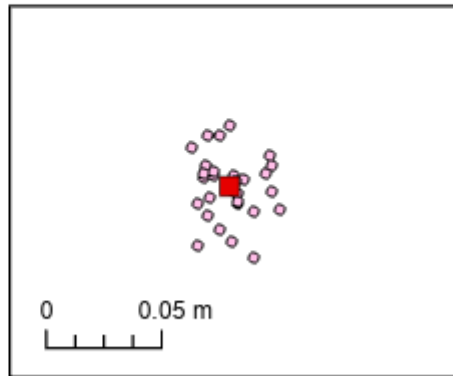
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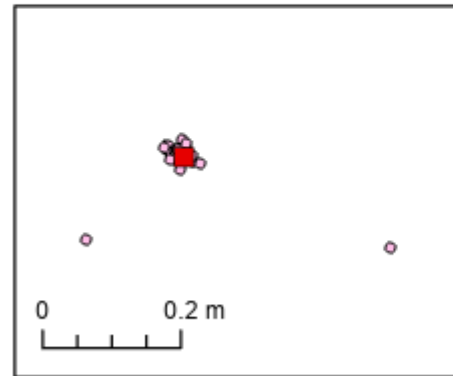
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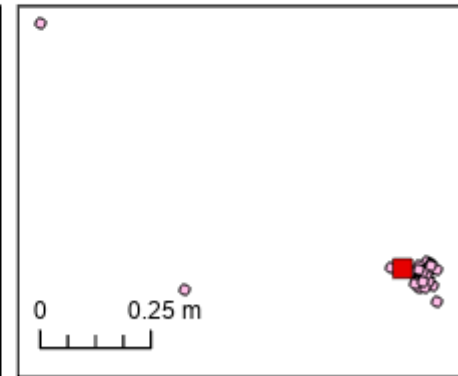
Point 8



Point 9



Point 10

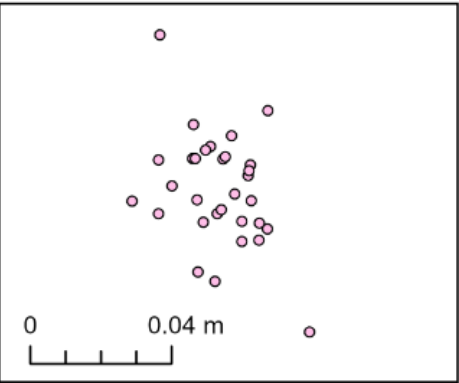


Point 11

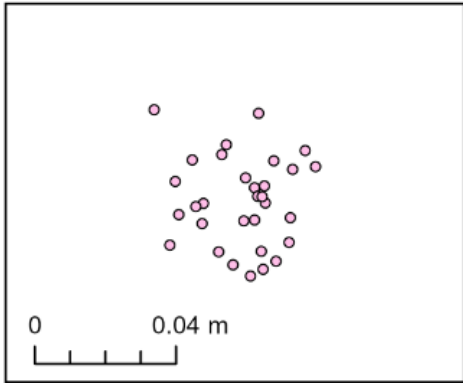
“Outlier” removal

- Based on the horizontal error estimation
 - No date or human pattern is found
 - Only 2.5% of total measurements were removed

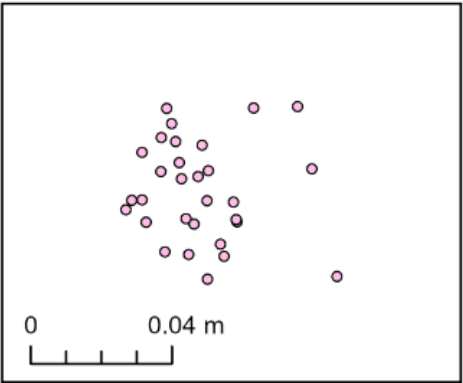
point	removed		
0	1	2/7/2025	
1	1	3/25/2025	
2	2	3/21/2025	4/15/2025
3	0		
4	0		
5	0		
6	1	3/21/2025	
7	1	2/27/2025	
8	0		
9	0		
10	2	2/21/2025	3/25/2025
11	2	2/27/2025	3/25/2025



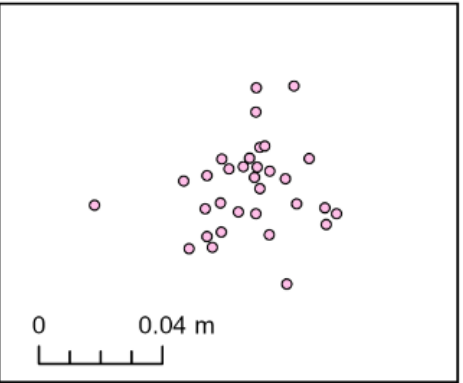
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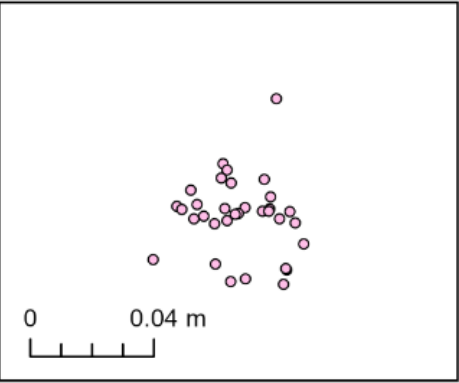
Point 1



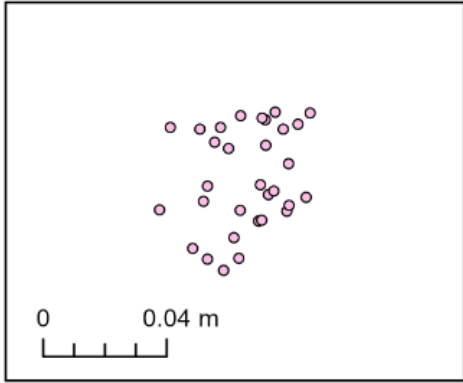
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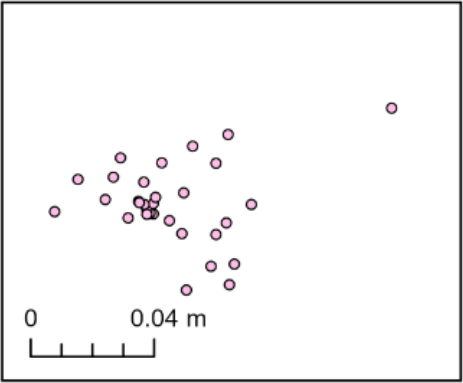
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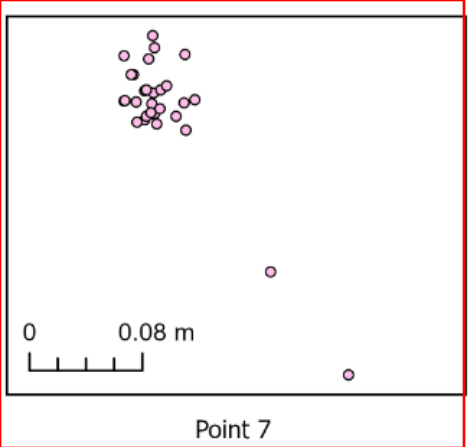
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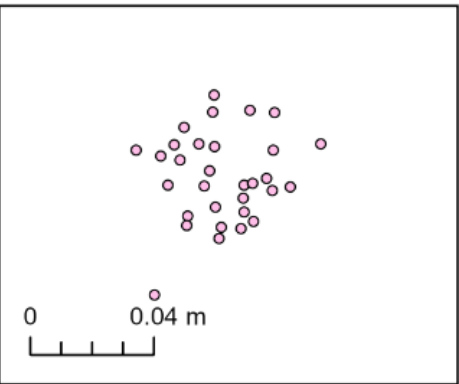
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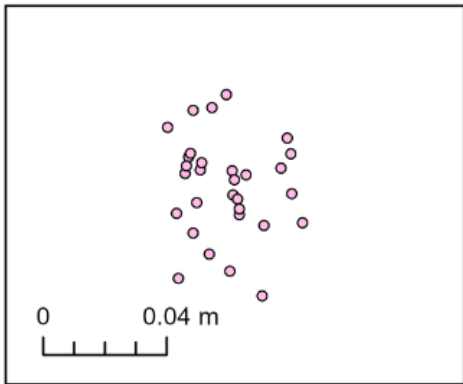
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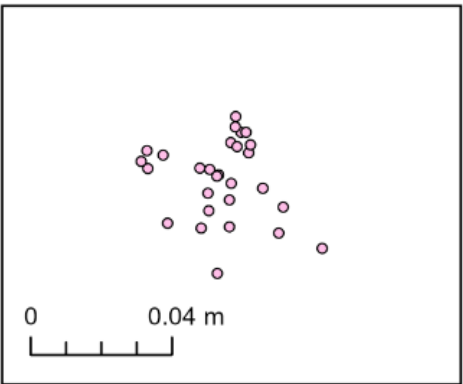
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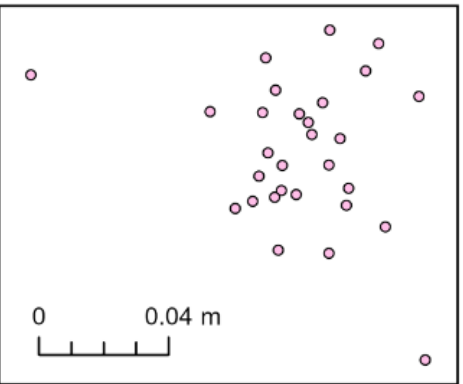
Point 8



Point 9



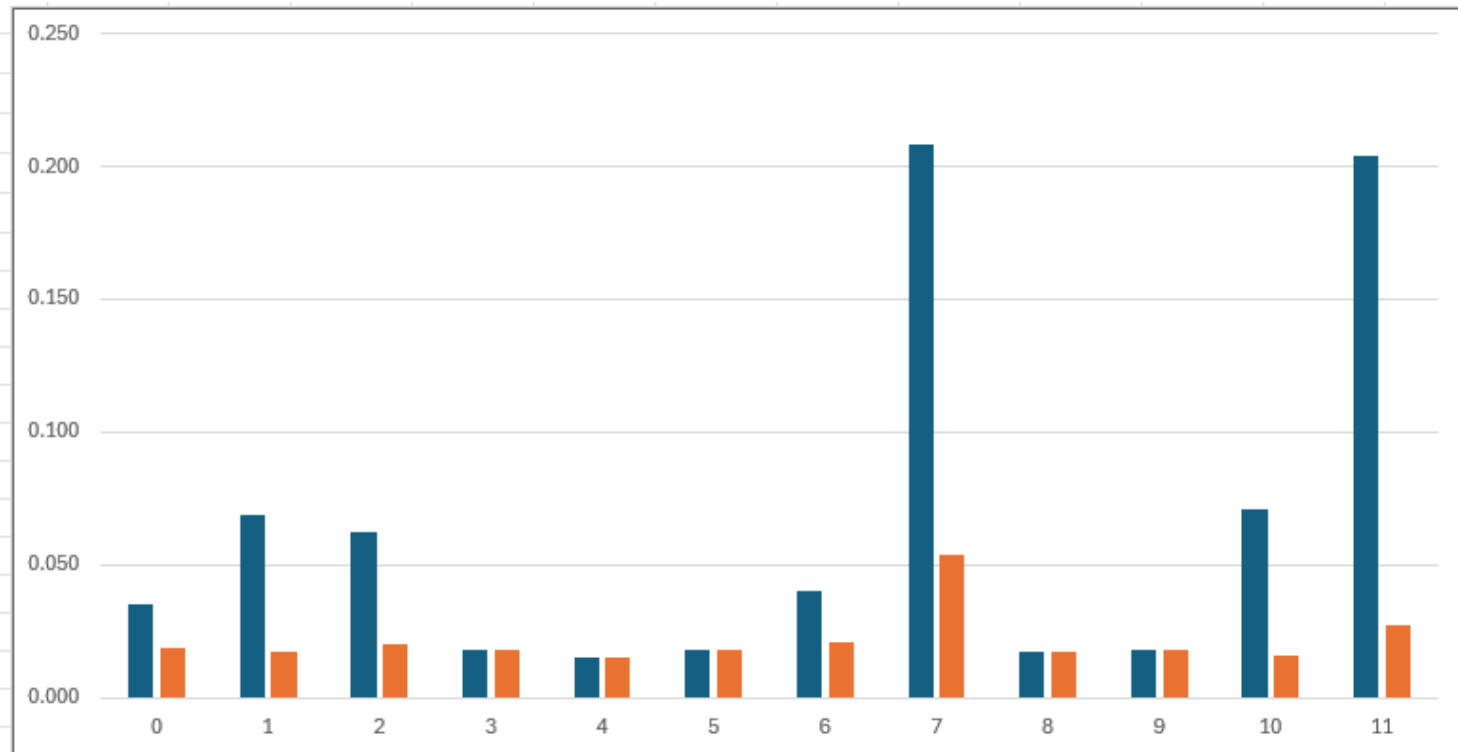
Point 10



Point 11

RMSE after outlier removal

- Plot (orange ones)





Limitation

- Rural area
- Very little elevation change
- May should have used Trimble data collector for less data processing
- Should go to more forested area
- Should have gone further

Summary

- RTK service really helps to achieve high precision in rural area of east Texas
 - There is a small chance (2.5%) to have data with relatively poor quality if the data were collected only once, even close to the RTK service base station
- Landcover matters
- Good internet service is critical



Acknowledgement

- Students

- Matt Petre, Victoria Williams, Dan Cagle, and John Jenkins

- McIntire-Stennis grant from USDA Forest Service

Thank You!



Questions?

Comments?

Suggestions?

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